

41 2815
#

Docket No. 57614 (71987)
[formerly 71987-10000]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: C. Huang et al.

U.S. SERIAL NO.: 09/916,021

GROUP: 2815

FILED: July 26, 2001

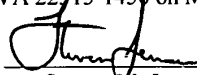
EXAMINER: C. Chu

FOR: SEMICONDUCTOR PACKAGE WITH HEAT SINK

.....

CERTIFICATE OF MAILING

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on May 11, 2004.

By: 
Steven M. Jensen

.....

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE TO OFFICE ACTION

Applicants are in receipt of the Office Action dated January 14, 2004 of the above-identified application. A request for a one-month extension of time is submitted herewith. Applicants respond to the Office Action as follows.

Claims 1-10 and 21-30 are pending in the application. Claims 23-30 were withdrawn from consideration as being directed to a non-elected invention.

Applicants' claimed invention is directed to a semiconductor package with a heat sink, in which a chip has a first surface attached to a chip carrier and a second surface attached to a heat sink by an adhesive, so as to allow heat generated by the chip to be transmitted to the heat sink.

05/17/2004 SDENB01 00000109 09916021

01 FC:1251

110.00 OP

The heat sink includes a top surface coated with an **interface layer**, such that adhesion between the interface layer and a molding resin that forms an encapsulant is smaller than adhesion between the heat sink and the encapsulant.

Applicants' claimed invention can yield significant benefits. According to the Applicants' invention, the heat sink comes into contact with the chip for improving heat-dissipating efficiency, and also prevents the chip from cracking in a molding process (see specification at page 3, first full paragraph). The invention can be implemented with the heat sink attached to the chip in a batch-type manner, thereby simplifying the process and reducing fabrication costs.

Claims 1, 2, 4-6, 9, 10, 21, and 22 were rejected under 35 USC 102(e) as being anticipated by U.S. Patent 6,309,915 to Distefano. Claim 3 was rejected under 35 USC 103(a) as being unpatentable over Distefano in view of U.S. Patent 4,521,801 to Kato et al. (hereinafter "Kato"). Claims 7 and 8 were rejected under 35 USC 103(a) as being unpatentable over Distefano in view of U.S. Patent 6,198,171 to Huang et al. (hereinafter "Huang"). These rejections are respectfully traversed.

Distefano fails to teach or suggest a semiconductor package having an interface layer formed on the second surface of a heat sink, where the interface layer is made of a material having adhesion with a molding compound smaller than adhesion between the heat sink and the molding compound, as recited in claim 1.

In the Office Action, thermal spreader 10 was cited as corresponding to both the heat sink and the interface layer of claim 1. Specifically, an invar layer and an upper copper layer were construed as the heat sink and the interface layer, respectively. However, the upper copper layer of a copper-invar-copper heat spreader (column 9, line 43) is not "made of a material having adhesion with a molding compound smaller than adhesion between the (invar layer) and the molding compound," as recited in claim 1.

According to the Applicants' claimed invention, the semiconductor package must include an interface layer having a smaller adhesion between the interface layer and the molding compound than that between the heat sink and the molding compound. For example, referring to FIGS. 2G and 2H of the application, the interface layer exhibits low adhesion to the molding compound after molding and singulation processes, so that any remaining molding resin 240A on the interface layer 233 can be easily removed by heating, without damaging the bonding of the heat sink 23 to the encapsulant 24 (see specification at page 9, first paragraph).

In contrast, Distefano describes a thermal spreader 10 having a coefficient of thermal expansion (CTE) close to that of the semiconductor chip, but does not teach or suggest the relative adhesions between the copper-invar-copper layers of the thermal spreader 10 and an encapsulant 3. Therefore, Distefano cannot anticipate or otherwise render obvious the Applicants' claimed invention.

On pages 4-5 of the Office Action, it was stated that the claimed limitation of "an interface layer ... made of a material having adhesion with a molding compound smaller than adhesion between the heat sink and the molding compound" was disclosed in U.S. Patent 4,528,613 to Stetson, according to page 8, paragraph 10 of the Office Action. However, in column 4, lines 54-60 of Stetson, a substrate made of invar is described, whereby the substrate forms "strong bonds" with ceramic glass material – the ceramic glass material is used to make a capacitor in Stetson. There is no teaching or suggestion that the invar material disclosed in Stetson forms a smaller adhesion with a **molding compound**, as compared to adhesion between a heat sink and the molding compound.

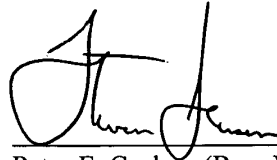
Therefore, Stetson cannot be combined with Distefano to somehow produce the Applicants' claimed invention, for at least the reasons discussed above.

Regarding the rejection of claim 5, it is noted that reference numeral 6 in Distefano corresponds to apertures 6 "used to provide access for a bonding tool..." (column 7, lines 32-34). Therefore, Distefano does not teach or suggest bonding wires for connecting the chip to the substrate, as recited in claim 5.

Regarding the rejections involving the Kato and Huang references, neither reference teaches or suggests "an interface layer ... made of a material having adhesion with a molding compound smaller than adhesion between the heat sink and the molding compound," as recited in claim 1. Therefore, for at least the reasons discussed above, neither reference can be combined with Distefano to produce the Applicants' claimed invention.

It is believed the application is in condition for immediate allowance, which action is earnestly solicited.

Respectfully submitted,



Peter F. Corless (Reg. No. 33,860)
Steven M. Jensen (Reg. No. 42,693)

EDWARDS & ANGELL, LLP
P.O. Box 55874
Boston, MA 02205

Date: May 11, 2004

Phone: (617) 439-4444

Customer No. 21874